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THE LAND SNAILS OF NEW ENGLAND.

PLATE 1.

BY E. S. MORSE.

We offer to our readers the first of a series of papers on the Land Snails of New England, with the intention of carefully figuring every species of land snail known to occur within the prescribed boundaries. We shall also give a general history of the group, mentioning the hiding places of different species, and whatever facts we may think of interest to the general reader.

Certainly a more unassuming subject could not well be studied, for aside from the soothing pleasure of lying down, dorsal region uppermost, in some secluded grove, and hunting for half a day among the decaying leaves, upturning the different layers of successive autumnal deposits of withered foliage, even as the geologist throws open the different pages of the "Great Stone Book," the earth's crust, in quest of material for study,—aside from this quieting pursuit, we have no stirring incidents in their life to contemplate, no frantic hops, skips, and jumps of the insect tribe, no terrible bites to dread, or poisonous stings to shrink from, no enemy of our husbandry (except occasional injury from the garden slug) to baffle, no giant stride or rapid speed to wonder at; for the snail is proverbially slow in every respect. When disturbed, it does not, like many other animals, struggle violently to escape, but ceases motion, or quietly withdraws itself within its shell. Even the heart, which in higher animals, when agitated, pulsates with increasing energy, in the snail under similar excitement, throbs with a slower motion. And yet we do believe that the careful study of a common snail will reveal the wonders of God's Providence in as forcible a manner as the history of the higher forms of animal life. Before presenting an account of the different species of land snails to be met with in New England, we must first learn something about the habits and anatomy of the group in general. Land Snails are universally distributed throughout the world, occurring under stones in open pastures, beneath the dead leaves and prostrate trees of the forest, in the interstices of bark, clinging to shrubs and spears of grass, lurking under damp moss, and occupying other positions of a similar nature. As they are dependant on the presence of a certain degree of moisture for their perpetuation and increase, they are more abundant in warm and damp regions, and are therefore found in greater numbers on islands, while in dry and desert places they are scarcely known to occur.

The land snails attain their greatest size and beauty in the tropics; the species diminishing in number and size as we approach the poles. Certain South American species attain the length of six inches, and the young when first hatched from the egg (which is as large as that of a pigeon), is an inch long.

We turn however with relief from the gaudy colored shells of the Equator, to our more humble representatives of the North, both modest and unpretending in size and color. The species native to the United States are essentially inhabitants of the forest, and there, dwelling under the damp leaves in continual darkness, do we seek the material for our study.

Figures 9, 10, and 11, plate 1, represent the common large snail of our woods, the white lipped snail or *Helix albolabris*. This snail is distributed throughout all the Northern and Western States, and is a fair type of the family. The body is quite soft, and spreads below into an oblong, flattened disk. This disk is called the "foot," and forms their only locomotive organ. By means of numerous minute muscles distributed closely along this flattened surface, they are enabled to creep along, at times with an almost imperceptible motion, gliding smoothly over the roughest substances, ascending branches, and even burrowing in the ground. When we consider this sluggish, and too often despised snail, without legs, fins, or wings, and yet performing the important function of locomotion with as much certainty and ease as animals more highly endowed, we cannot but admire the versatility of the Great Creative mind in the various complete provisions made for the locomotion of all these humbler animals. During progression, the disk, or surface upon which they crawl, secretes a slimy, or viscid substance, which greatly facilitates their exertions, and they can often be traced to their hiding places, by following the silvery trail, which all snails leave behind, in their peregrinations. The English gardener, annoyed as he is by the depredations of certain species of snails, which nip the tender buds, and even devour the leaves of his plants, frustrates their destructive raids by encircling the plants with an earth work of dry sand; or better still, ashes. The snail, in attempting to pass this barrier, becomes completely entangled with the particles of sand adhering to its slimy body. Now, any irritation of this nature causes the snail to pour out this slime, or mucus, from all parts of the body, as can be easily proved by irritating the snail with the point of a stick, when shortly a ball of mucus will be formed on the stick, and the point finally rendered smooth. This provision to guard against such conditions, fairly exhausts the snail in its attempts to pass the barrier, for the more abundant the secretion, the greater the entanglement, and finally the snail dies from exhaustion. Protections of this kind would be of no use in rainy weather, as the sand adheres together, and the snail can then pass over it very easily.

Certain species of slugs (Fig. 13, Plate 1), that is, snails having no coiled shell, but alike in other respects, have the singular power of lowering themselves from some projecting point by means of this mucus, which they throw off from the posterior end of the creeping disk; and we have seen a common slug (a species occurring abundantly in our garden and fields), lower itself from the back of a high chair to the floor. They have no power, however, like the spider, to retrace their course. They will often hang suspended in mid air for sometime, apparently for no other purpose than to enjoy themselves.

The snail has no power to leave its shell as many suppose. The shell is as much a part of the animal, as is the hard crust of a beetle a component part of the insect. And not only this, the snail is attached to the shell by a permanent muscular attachment, and cannot be withdrawn from it alive. In order to clean the shell of its contents, it is customary to scald it in boiling water, when the muscular attachment becomes separated from the shell, and the soft parts can be easily removed. The finding of empty shells in the woods, has oftentimes been cited as a proof that the snail can leave its shell, and the occurrence of certain species of snails which have no visible shell, has served to strengthen a belief in this error. When the creature dies, the soft perishable parts are soon decomposed, or else devoured by insects, leaving the more enduring shell as a monument to its memory. On the approach of winter, or the continuance of a severe drought, the snail hybernates, that is, it ceases to feed, and withdraws itself far within its shell, leaving at the same time several barriers within the aperture of the shell, composed of the mucous secretions of the animal. In this condition it remains, motionless and apparently lifeless. The mode of forming these partitions is quite curious, and will interest the observer. As the snail withdraws within the shell it inspires a certain quantity of air; the creeping disk, and the parts of the animal bordering the aperture of the shell pour out a certain quantity of mucus, which stretches completely across the aperture of the shell. This soon hardens, and the snail by expiring most of the air in its lungs, and thus reducing its bulk, retires still farther within its shell, and again forms a barrier similar to the one just formed, and oftentimes several partitions are formed in this way, one behind the other, affording a complete protection against the inroads of cold and water, and apparently of heat as well, since they always do this when confined in a dry or hot place. In a certain foreign species, this partition partakes of a calcareous nature, and thus affords a more enduring barrier. In the spring time the snail resumes its activity, the barriers are forced through by the tail, and frequently the snail devours them, as if famishing after its long continued fast.

All species of land snails with few exceptions, are oviparous; that is, the young are hatched from eggs laid by the parent. The sexes are united in each individual, though the mutual union of two individuals is necessary to fertilize the eggs. They lay from fifty to one hundred eggs at a time. The eggs of most species are very small, white in color, and resemble homœopathic pills. If the conditions are favorable, the young issue from the eggs in the course of two or three weeks, furnished with a shell composed of one whorl and a half. The shell is increased in size by the addition of calcareous matter round the margin of the aperture. The successive lines of growth can be easily traced on the shells of most species. They attain their complete growth in from one, to two years. The number of eggs produced by an individual varies in proportion to the greater or less protection afforded to the animal; thus in the common slug, *Limax*, and allied genera, having no exterior shell into which they may withdraw in times of danger, the number of eggs produced is much greater, and according to Dr. Leach, who kept two specimens of the common garden slug in confinement, seven hundred and eighty six eggs were laid in one year.

The vitality which the snail's eggs possess surpasses belief. Certain French naturalists assert that they have been so completely dried, as to be friable between the fingers. In this dried condition they have been kept for a long time, and yet a single hour's exposure to humidity and warmth, has been sufficient to restore them to their original form and elasticity. They have been dried in a furnace eight successive times, until they were reduced to an almost invisible minuteness, yet in every instance have they regained their original bulk in a moist situation. In all these instances the young have been developed, in the same manner as other eggs not subjected to this experiment. (Binney.) This wonderful vitality extends to the snail in all stages of its existance. We have seen certain species frozen in solid blocks of ice, and yet regain their activity when subjected to the influences of warmth. Their dependence on moisture naturally places them in moist situations, yet we have seen certain species attached to leaves, where the sun had shed its scorching rays for weeks, crisping the leaves, and baking the ground as dry as potter's ware, and yet these conditions not affecting in the least their vitality. They have been kept for years in pill boxes, and yet on subjecting them to moisture, have crawled about appearing as well as ever. In "Woodward's Manual of Shells" is the following, chronicled by Dr. Baird, regarding the resuscitation of a desert snail. "This individual was fixed to a tablet in the British Museum on the 25th of March, 1846, and on March 7th, 1850, it was observed that he must have come out of his shell in the interval (as the paper had been discolored, apparently in his attempts to get away) but finding escape impossible, had again retired, closing his aperture with the usual glistening film; this led to his immersion in tepid water and marvellous recovery." The power possessed by the snail to reproduce certain portions of its body removed by violence, has long attracted the attention of Zoölogists. The horns, or tentacles, and even portions of the head have been cut away, and in due course of time these lost parts have been restored by a new growth. The whole head has been cut away, and though in many cases terminating the life of the victim, yet in some instances the parts removed have been fully restored. This seems the more wonderful when we consider the complicated character of the head and mouth. The shell may be broken, and even portions of it removed, and yet after a certain lapse of time the injured parts will be repaired by a deposition of shelly matter at the fractured parts. We have thus far examined briefly the general history of the snail. Let us now proceed to examine more minutely its anatomical characters.

Figure 10, on plate 1, represents the common large snail of the woods, the white lipped Helix, or technically speaking, *Helix albolabris.* It is represented as crawling, and consequently extended fully from the shell. The two larger and two smaller "horns" projecting from the head, are respectively called the upper or superior, and lower or inferior tentacles. The superior tentacles are the longest, and stand uppermost; at the tips of these are found the eyes, little black specks, though large enough to be distinctly visible. The eyes are very simple in structure, and probably serve no important use, as the snail in progression, appears to depend entirely on the tentacles as feelers to guide the way. While they crawl, the tentacles are continually in motion, and the tips oftentimes come in contact with various objects on the way. If the eyes were capable of ordinary vision, this occasional contact of the tentacles would be avoided.

That the sense of smell is enjoyed by the snail has long been known, since they will oftentimes travel some distance in quest of food for which they have a particular fondness; the exact seat of this sense, however, has long been a disputed question. An eminent French Naturalist believes it to be seated at the extreme tip of the larger tentacles. A magnified drawing is given (Fig. 1, Plate 1,) of the end of the larger tentacles to show the position of the nerves supposed to be the nerves of smell, or the olfactory nerves, (*o*, Fig. 1,) these are seen as minute threads or branches terminating at the extreme end of the bulb-like tentacle. In this figure the eye is also seen with the optic nerve. (*e*. eye, *op*. optic nerve.) The larger tentacles are retractible, that is, they have the power of withdrawing within the head, the eyes disappearing first, as a glove finger disappears as it is withdrawn over the hand, turning the glove wrong side out. The smaller, or inferior tentacles, have not this power of withdrawing within the head, but remain always extended. When the snail is feeding, it is very curious to observe the listless appearance of the larger tentacles. A dog, or a cat, when feeding will often partially close the eyes and appear drowsy. It would seem that similar sensations are experienced by the snail, for while feeding, the tentacles are partially drawn within the head and hang downward, as if the delights of feeding were altogether too engrossing to mind the lax state of the tentacles. When on the trail, however, the tentacles are thrust out to their greatest length, perfectly rigid, and give an appearance of alertness to the snail that it does not possess. Just beneath the lower tentacles the mouth is situated, having on the upper lip a crescent shaped jaw, (Fig. 7, Plate 1,) of a heavy texture, and quite hard. In some species of snails, the jaw is quite smooth, and has a slight projection on the cutting edge. In other species, the larger ones especially, the jaw is ribbed, and the cutting edge is notched and jagged like so many teeth as it were. In fact this jaw answers all the purposes of an upper set of teeth, for it is capable of biting through the thick leaves of a cabbage; as can be easily proved, by keeping a snail in confinement, and feeding it on cabbage or lettuce, of which it is very fond. When feeding, all the movements of the mouth are plainly visible, and not only can the little semi-circular cuts of the jaw on the leaf be seen, but while feeding the nipping sound of the bite can be distinctly heard. The larger snails are also very fond of flour paste, and while luxuriating in this simple diet each white mouthful can be easily traced in its course, from the mouth to the stomach, owing to the translucency of the snail's body. The lower lip is not furnished with a plate, but just within the mouth there is spread a membrane, very appropriately called the *tongue*, or lingual membrane, as the snail uses it in lapping its food. This membrane is quite long and broad, and is covered with minute silicious denticles, or teeth, as they are called.

As an object for the microscope, it will repay one the trouble attendant on dissecting this membrane from the mouth of a snail. A magnified figure of the entire tongue is given on plate 1, fig. 6. Nothing can exceed the beauty and regularity in the form and arrangement of the denticles. These are pointed and turn backwards, thus forming a series of little claws and hooks, and are admirably adapted to perform the rasping function allotted to them; fig. 5, plate 1, gives a side view of a few of these teeth to show their hooked character. The number of denticles on the tongue is very great. Some species, the white-lipped Helix, for instance, having nearly twelve thousand denticles. It is difficult to conceive the minuteness of these particles, when we consider that the membrane on which they rest is not a quarter of an inch long, and only half as wide. The denticles are arranged in regular longitudinal and transverse rows. Figure 3, plate 1, represents two transverse rows of these denticles, and fig. 4 a central tooth, with lateral teeth more highly magnified to show their form. It will be noticed that the central denticles are symmetrical in form, having the two sides alike, while those on each side are not symmetrical. In illustrating the dentition of a species, it is only necessary to draw one half of one transverse row, including the central denticle, at the same time mentioning the number of transverse rows on the membrane; thus in the white-lipped Helix, a specimen of which we examined, we found eighty-nine denticles in a transverse row, that is, one central denticle, flanked on each side by forty-four lateral denticles. There were one hundred and twenty-three transverse rows, making the whole number of denticles on the membrane ten thousand nine hundred and forty-seven, or, about eleven thousand. The form, and number of denticles in each species vary, as we shall show hereafter.

In looking for the breathing hole of the snail, those ignorant of its structure might refer to the mouth as the opening through which it inhaled air. It is a common idea that insects breathe through the mouth, because the higher animals do so. Now insects breathe through little perforations on the sides of their body, and the snail has an aperture on the right side of its body, just within the aperture of the shell, through which it breathes. This aperture can be plainly seen in the mantle or skin which fills the mouth of the shell, (Fig. 11, a, Plate 1) by turning the snail over. The lung is a simple cavity, lined with a net work of blood vessels. The blood is a bluish colored fluid, and is circulated through the body and lung, by a pulsating heart composed of two chambers, an auricle and a ventricle, separated by a double valve. The heart's pulsations can be distinctly seen through the lower part of the translucent shell of many species. Fig. 2, *h*, plate 1, represents the heart situated in the pulmonary cavity. In this figure the lung is represented as turned back from the animal, exposing the heart. Fig. 12 represents the heart and lung of a common slug. It would lead us too deep into the anatomy of the snail, were we to indicate the character and position of the liver, kidney, and many other organs which combine to make up the complicated structure of our apparently simple snail. Suffice it to say, that however insignificant many of the lower animals appear to the common observer, yet a description of their minute anatomy alone would form many a chapter of surpassing interest to those who delight in contemplating the perfection of God's works.

In our next paper we shall commence the description of the different species of land snails to be found in New England.

EXPLANATION OF PLATE 1.

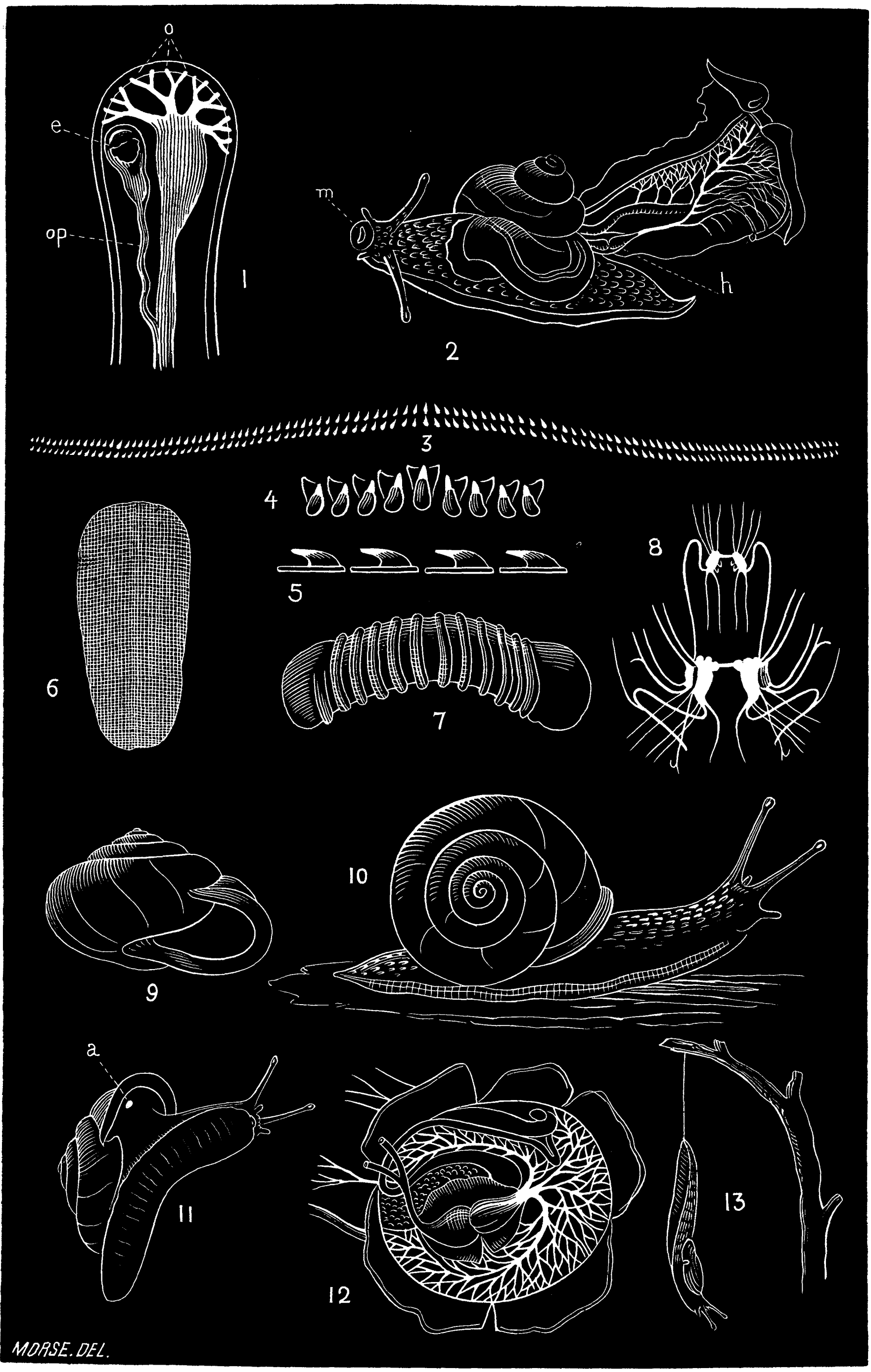
Fig. 1. Magnified view of superior tentacle of a snail. *op.* optic nerve; *e.* eye; *o.* olfactory nerves.
Fig. 2. *Helix albolabris*, with shell removed and mantle thrown back, showing lung and heart. *m.* mouth; *h.* heart.
Fig. 3. One row of teeth from the same, magnified.
Fig. 4. A portion of one row of teeth from the same, highly magnified.
Fig. 5. Side view of teeth of the same.
Fig. 6. Entire tongue of same, enlarged.
Fig. 7. Jaw of same, magnified.
Fig. 8. Nerve centres of *Helix albolabris.*
Fig. 9. Shell of *Helix albolabris.*
Fig. 10. *Helix albolabris* crawling.
Fig. 11. " " turned back, showing orifice to lung, *a.*
Fig. 12. Lung and heart of Garden Slug, *Limax flavus.*
Fig. 13. Slug suspended from twig.

THE VOLCANO OF KILAUEA, HAWAIIAN ISLANDS, IN 1864-65.

PLATE 2.

BY W. T. BRIGHAM.

Soon after one o'clock we came upon the brink of the great crater. From below us steam and vapor rose in a sluggish column, but we saw no fire and heard no noise: the conflagration had, as it were, left nothing but smoking ruins to mark the scene of its triumph. The deep plain before us was surrounded with steep rock-walls, from



MORSE ON THE LAND SNAILS OF NEW ENGLAND.